Wood Contract No:	7650
Client's Name:	INEOS
Project Title:	Project One
Project Location:	Antwerp, Belgium

Revision	**A9**	**Signature**	**A10**	**Signature**	**A11**	**Signature**
DATE	12 Feb 2021		20 Aug 2021		12 Nov 2021	
Originator	A Tremlett	AT	A Alyousif	AA	A Alyousif	Abdul-Rahman Alyousif 2021.11.10 10:26:14Z00'00'
Checked	D Bishop	DB	D Bishop	DB	D Bishop	Duane Bishop 2021.11.10 14:28:12Z00'00'
Approved Deputy Engineering Manager	D Bishop	DB	D Bishop	DB	D Bishop	Duane Bishop 2021.11.10 14:28:23Z00'00'
Approved Engineering Manager	D Smith	DS	D Smith	DS	D Smith	David G Smith Date: 2021.11.10 17:17:17Z00'00'

CONTENTS

Section	Summary of Change	Revision Number
-	Removal of HOLD 2, 3, 4	A7
2	Updated overall site plan document number	A7
2, 5.11, Att 1	Addition of Zwijndrecht specific information	A7
3.1	Inclusion of “existing site-specific standards”	A7
3.3	Added reference to Hazardous Area Classification Basis and Review, and removed internal “Met data basis” reference as this document is not required by Contractors.	A7
5.2.2	Winterisation temperature updated to -15°C to match the Winterisation Philosophy (7650-8110-PH-100-0003)	A7
5.13	Seismic data updated following site specific Fugro PHSA Report 147299_REP_INEOS_SHA_2019	A7
7.3	Water conditions/quality updated based upon information received from Water-link (provider).	A7
-	Removal of HOLD 1,	A8
All	Update to reflect revised scope	A8
2	Update of elevation datum and addition of Zwijndrecht plant coordinate information	A8
3.3	Added reference documents	A8
4	Added “piping” design life, and clarification to use Larson Miller parametric equation	A8
5	Added Terrain Category I	A8
5.1.1	Clarified use of 41 m/s for loading arms in stored position	A8
5.2	Added sentence for clarity regarding reference data vs design data.	A8
5.2.11	Added reference to NBN EN ISO 7730 for HVAC	A8
5.4	Additional rainfall data added which shall be used in conjunction with Drainage Specification	A8
5.6	Added maximum rate of pressure change	A8
5.16	Added clarification of design groundwater level	A8
7.1.1	Added design pressures for steam	A8
7.3.6	Added clarification that firewater material selection for underground firewater piping can be based upon the maximum operating temperature of 20C	A8
7.3.6	North site firewater conditions removed	A8
7.4.1	Instrument air hold up time updated from “none” to “15 mins”	
7.5.1.2	Process Off-gas composition for PDH unit deleted	A8
8.1	Deleted information from here, as detailed in Piping specifications and line lists developed by Contractor	A8

Section	Summary of Change	Revision Number
9.1	Update to incoming power, and in-plant voltage	A8
5.1.1	Minor text adaption to clarify for loading arms only those in the stored position need to consider the instantaneous windspeed of 41 m/s	A9
7.3.2	City Water quality: min, max and percentile data added for greater definition. Alkalinity and silica parameters added.	A9
7.3.4	Service water section updated to detail blend of demineralised water and city water (previously 100% city water)	A9
7.4.1	Instrument air header pressure update	A9
5.4	Clarification of average rainfall data	A10
7.1.1/7.1.2	Minimum pressure of S42 at users has been decreased to 38 barg in line with ECR/OSB agreement (IQ-OSB0-ECR0-021)	A10
7.3.2	City Water pressure added	A10
7.3.3	Desalinated water section re-instated	A10
7.3.8	Description added to detail that demineralised water is a mixture of Waterlink demin water and the treated condensate (polished water)	A10
7.3.8	Supply conditions for demineralised water to be agreed via IQ	A10
7.4.1	Dewpoint of instrument air updated to “Pressure Dew point”	A10
9.1	Removal of HOLD 6	A10
7.4.3	Removal of HOLD 5	A10
A.2.1	Removal of HOLD 7	A10
7.5.1	Removal of HOLD 8	A10
3.1	Introduction of Contractor Amendment Sheets	A11
7.4.1	Instrument Air supply temperature increased from 60°C to 65°C	A11
7.4.3	Nitrogen Header Temperature increased from 60°C to 65°C	A11
7.3.4	Service water is now only city water as per DR-ONE-WD-IN-PRO-133	A11
7.3.6	Removal of reference to integration with Inovyn and north and south sites.	A11

Hold No.	Document Section	Reason

1. PURPOSE

This document presents the Basic Engineering Design Data (BEDD) for the facilities associated with the INEOS "Project One" program. It provides the base data upon which other technical documents are based, and upon which all other disciplines shall base their work. The data is applicable to all projects in the program and to all areas within each project.

2. PROJECT DESCRIPTION

Client Name	INEOS
Project Name	Project One
Country	Belgium
Location	Port of Antwerp

The facility will be located over two main sites; a North Site and a South Site:

Plant Grid N 0.000 = Lambert 72 Y 222143.606
Plant Grid E 0.000 = Lambert 72 X 144605.799

Plant North = 21.95527600° West of True North

Elevation Datum= TAW
*TAW= Tweede Algemene Waterpassing (local Belgian system)

See Overall Site Plan (7650-8230-01-100-0001).

Project One scope also includes re-purpose of an existing INEOS Ethylene Tank and Jetty at Zwijndrecht, Antwerp. New Project One facilities at Zwijndrecht include a multiple-train refrigeration package. The plant coordinates for Zwijndrecht shall be based on the INEOS plant Grid System for Zwijndrecht and the elevations shall be relative to the local plant elevation system BNKD (+8.250 BNKD = +7.984 TAW).

The program will design and construct a world class olefins facility comprising:

- Ethane Steam Cracker (ECR) producing 1450 kta of Ethylene;
- Outside Battery Limits (OSBL): Utilities, offsites and logistics

The ECR process unit will be located on the South Site.

The program will be managed by an Integrated Program Management Team (IPMT).

2.1 Project Type

This is primarily a grass roots program of projects being built on brownfield sites.

2.2 Process, Utility and Offsite Facilities

The main facilities included are listed below:

Unit Description	New unit	Revamp	Expansion
Ethane Cracker	X		
Flare	X		
Power Generation	X		
Instrument Air	X		
Plant Air	X		
Nitrogen	X		
Cooling Water	X		
Demineralised Water	X		
Fire Water	X		
Waste Water Treatment	X		
Desalination	X		
Fuel Gas	X		
Steam	X		
Steam Condensate	X		
Tank Farm	X		
Jetty	X		
Ethylene Liquefaction, Storage and Export	X	X	X
Propylene Storage and Export	X		
Product Pipelines		X	X

There are also tie-ins to facilities outside the plant including Water, Fuel Gas and Export Pipelines.

3. APPLICABLE DESIGN STANDARDS

3.1 Order of Precedence

The applicable design standards (design Codes, International Standards, Government Acts, Local Authority regulations, etc. and Program specific requirements) are to be based on European standards, incorporating requirements of any mandatory local regulations and codes. American (or other) standards shall be followed where specified. Where there is a conflict in standards, IPMT shall be advised and reserve the right to be consulted to review the recommended resolution before implementation. It is expected the most stringent requirement shall govern.

1. Statutory requirements; local and national
2. Licensor standards (where required to meet plant performance and guarantees and formally agreed with INEOS)
3. Contractor amendment sheets to program specific standards where formally agreed with INOES
4. Program-specific standards
5. INEOS Group Operations Guidance Notes
6. Licensor standards
7. International standards

8. Existing site standards

3.2 Specifications and Standards

The main applicable program specific standards, international (and industry) standards to be followed are listed in the Standards Index (7650-8820-IN-100-0002).

3.3 Reference Documents

The following set of documents shall be read in conjunction with this document:

Document No.	Title
7650-8110-PD-100-0001	Basis of Design - Process
7650-8150-PH-100-0001	Safety Philosophy
7650-8150-PH-100-0002	Environmental Philosophy
7650-8230-PH-100-0001	Piping & Plant Layout Philosophy
7650-8310-PH-100-0001	Civil and Structural Philosophy
7650-8310-SP-100-0012	Drainage Design Specification
7650-8340-SP-100-0001	HVAC Basis of Design
7650-8370-FS-900-0001	Marine Functional Specification
7650-8330-PH-100-0001	Buildings Philosophy
7650-8430-PH-100-0001	Mechanical Philosophy
7650-8530-PH-100-0001	Electrical Philosophy
7650-8540-PH-100-0001	Telecommunications and Security Philosophy
7650-8550-PH-100-0001	Control & Instrument Philosophy
7650-8820-PH-100-0001	Modular Design Philosophy
7650-8820-IN-100-0002	Standards Index
7650-8820-PR-100-0005	CE Marking Strategy
7650-8820-PR-100-0011	Hazardous Area Classification Basis and Review
7650-8820-PR-100-0012	Compliance & Conformity Guidance
1319-0065.MR01	Groundwater Monitoring Report North Site
1319-0065.MR02	Groundwater Monitoring Report South Site

4. DESIGN LIFE

Design life shall be in accordance with the respective American Petroleum Institute (API) codes for equipment, for other items the below minimums shall apply:

Minimum Design Life	
All equipment and piping unless explicitly stated different below or within API	20 years
Buildings	Eurocode 0 Category 4
Concrete and Steel Structures	Eurocode 0 Category 4
Pump Cases	API
Strainers	15 years
Replaceable Pump Trim & Internals	API
Equipment and Piping in Creep Stress Range (including Cracking Furnace convection section bundles)	200000 h*
Cracking Furnace Radiant Coils	100000 h
API Std 560 Fired Heater Coils (Rupture Design Life)	100000 h

* The Larson Miller parametric equation can be used for determining the reduced allowable stress for 200000 hours where values are only available on 100000 hours.

5. CLIMATIC DATA

5.1 Wind

5.1.1 Wind Velocity and Direction

Maximum Velocity (3 second gust) 35 m/s
(10m above ground level; 50 yr return period)

The site at Lillo is exposed and may be subject to wind speeds more associated with a coastal location.
For survivability, where critical in design and required by Codes and Standards, it may be appropriate to apply an instantaneous wind speed of 41 m/s (50 year return period based on Middelkerke weather station). For loading arms, this criterion is only applicable for loading arms in the stored position.

For design of buildings and structures a 10 min mean basic wind velocity of 25 m/s shall be used.

Terrain Category shall be taken as ‘Category I’.

Parameter	N	NNE	NE	ENE	E	ESE	SE	SSE	S
% Time	4.6%	4.7%	4.1%	5.3%	6.7%	4.5%	3.3%	3.9%	6.1%
Average Wind Speed (m/s)	2.5	2.6	2.9	2.8	2.6	2.2	2.4	2.8	3.6
Parameter	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**Calm**	**Omni**
% Time	10.9%	11.7%	10.0%	8.7%	4.1%	3.0%	3.9%	4.4%	100%
Average Wind Speed (m/s)	4.5	4.5	4.8	4.3	4.4	4.0	3.3	N/A	3.5

Table 1: Directional distribution of Operational Wind Speeds

5.1.2 Wind Loading

Structural and mechanical wind load pressures are derived from the methodology defined within Eurocode 1, NBN EN 1991-1-4 and the supplementary National Annex NBN EN 1991-1-4-ANB.

5.2 Air Temperature

5.2.1 Reference Data

For information, Table 2 and 3 below provide reference air temperature data. See Section 5.2.2 for design temperatures.

Parameter	Return Period		Observed High Temperatures				
	1-Year	10-Year	Max	99%ile	98%ile	95%ile	Average
Dry Bulb	34.3	35.8	36.7	27.2	25.0	22.2	10.8
Wet Bulb	24.6	26.1	27.9	20.2	19.2	17.5	8.5

Table 2: Maximum Temperatures (°C)

Parameter	Return Period		Observed Low Temperatures				
	1-Year	10-Year	Min	99%ile	98%ile	95%ile	Average
Dry Bulb	-18.3	-20.5	-18.3	-5.0	-2.8	-0.6	10.8
Wet Bulb	-18.8	-21.3	-20.5	-6.3	-4.3	-1.9	8.3

Table 3: Minimum Temperatures (°C)

5.2.2 Design Temperatures

Description	Design temp		Remark
Maximum Recorded	36.7	°C	
Minimum Recorded	-18.3	°C	
Mean Temperature	10.8	°C	
Design Maximum Ambient Temperature	27.2	°C	99%ile
Design Minimum Ambient Temperature	-5.0	°C	99%ile
Winterizing Temperature	-15.0	°C	
Thermal (Heat Rejection) Design of Air Coolers (dry-bulb)	27.2	°C	
Design Ambient (wet-bulb)	20.2	°C	99%ile
Design of Air Compressors	-5.0	°C	Min @ 70% RH
	27.2	°C	Max @ 60% RH
Design of Gas Turbines	-5.0	°C	Min @ 70% RH
	27.2	°C	Max@ 60% RH
Design of Fans and Air Blowers	-5.0	°C	Min @ 70% RH
	27.2	°C	Max@ 60% RH

The Minimum Design Metal Temperature (MDMT) for equipment and piping shall be the lowest of the Minimum Recorded temperature and the minimum design temperature due to any operating or upset condition.

For HVAC design the ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) guidance and NBN EN ISO 7730 should be followed, as per the HVAC Basis of Design (7650-8340-SP-100-0001).

5.3 Relative Humidity

	Value	Unit
Observed maximum value	100	%
Observed minimum value	16.3	%
Observed maximum of daily means	100	%
Observed minimum of daily means	31.8	%
Average monthly humidity	Table 4	
Design maximum	100	%
Design minimum	16.3	%
Observed maximum absolute humidity	0.027	kg/m^3
Design absolute humidity	0.03	kg/m^3

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average value	84.6	81.6	78.1	72.7	72.1	72.9	73.4	74.6	79.4	82.5	85.4	86.0

Table 4: Monthly Average Humidity (%)

Range of Humidity%	Associated Air Temperatures °C								
	Min	1%ile	2%ile	5%ile	Mean	95%ile	98%ile	99%ile	Max
0-20%	Insufficient Data								
20-30%	0.6	3.9	5.2	7.6	23.8	33.9	35.0	35.0	36.7
30-40%	-9.4	1.4	4.4	7.2	21.3	31.1	32.8	33.3	35.0
40-50%	-10.6	-0.6	2.8	6.7	19.0	28.9	30.6	31.1	34.4
50-60%	-15.0	-1.7	1.4	5.0	16.7	26.1	27.8	28.3	33.9
60-70%	-15.0	-2.8	-1.1	2.2	13.9	23.3	25.0	26.1	31.1
70-80%	-16.7	-5.0	-2.8	0.6	10.8	20.6	22.2	22.8	29.4
80-90%	-17.2	-5.0	-3.3	-1.1	9.3	17.8	19.4	20.6	30.0
90-100%	-16.1	-5.0	-3.3	-1.7	7.4	16.7	18.3	18.9	23.9

Table 5: Humidity and Associated Air Temperatures

5.4 Rainfall

Maximum recorded annual	906	mm
Minimum recorded annual	366	mm
Average annual	694	mm
Design rainfall per hour	as per table below	mm

The above data is based upon recorded measurements at Deurne, to the East of Antwerp.

The total annual average calculated from sum of monthly averages reported in 'Klimaatstatistieken van de Belgische gemeenten, Antwerpen (NIS 11002), by KMI, www.meteo.be, is 848.4mm.

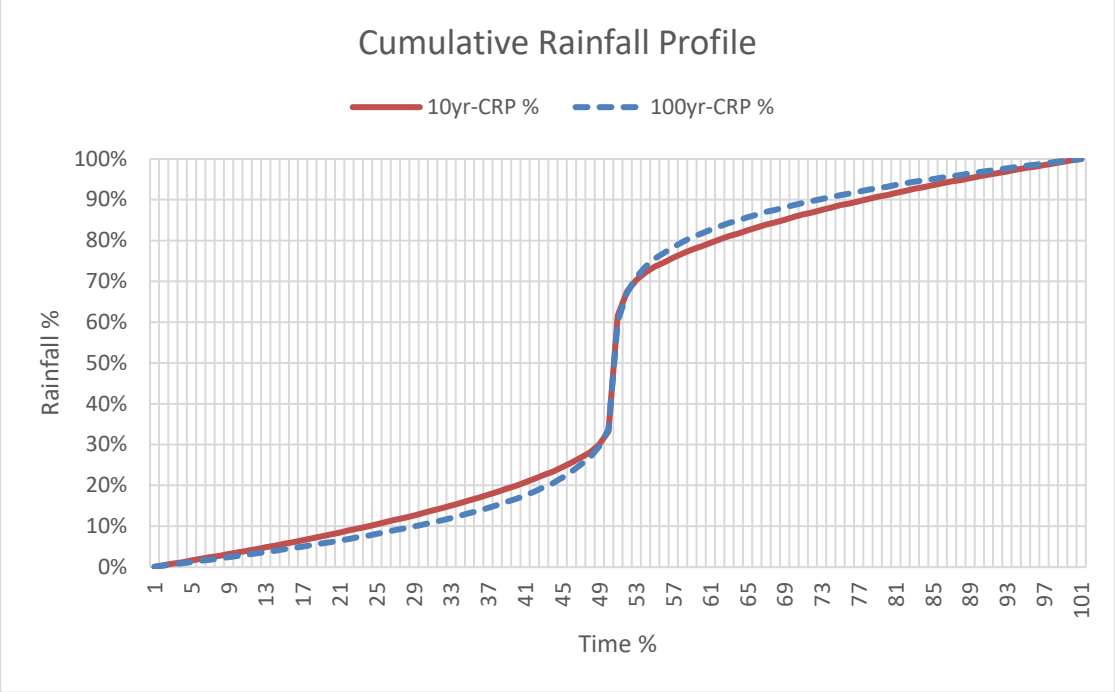
Rainfall Duration	2-Year	5-Years	10-Years	50-Years	100-Years
10-minutes	7.7	11.0	13.5	20.0	23.2
20-minutes	11.1	15.9	19.5	28.9	33.5
30-minutes	13.1	19.0	23.4	34.8	40.4
1-hour	16.2	22.8	27.7	40.2	46.3
6-hours	26.1	34.4	40.6	56.2	63.7
12-hours	31.8	41.8	49.1	67.7	76.6
24-hours	39.0	50.4	58.7	78.9	88.4

Table 6: Design Rainfall (mm) by Duration

Additional information on the source data for Table 6 may be found in 'Klimaatstatistieken van de Belgische gemeenten, Antwerpen (NIS 11002), by KMI, www.meteo.be.

5.4.1 Cumulative Rainfall Profiles

Cumulative Rainfall Profiles (CRP) for design of drainage systems covering 10-year and 100-year return periods have been developed based on Flanders “Code of Good practice for drainage systems” and Flanders Environment Agency (VMM) climate scenario data. An additional allowance of 10% shall be added to rainfall design data to take account of climate change, as per the Drainage Design Specification (7650-8310-SP-100-0012).



Time	10yr-Rain	100yr-Rain	Time	10yr-Rain	100yr-Rain	Time	10yr-Rain	100yr-Rain
0%	0%	0%	35%	17%	14%	70%	86%	89%
1%	0%	0%	36%	18%	14%	71%	87%	90%
2%	1%	1%	37%	18%	15%	72%	87%	90%
3%	1%	1%	38%	19%	16%	73%	88%	91%
4%	2%	1%	39%	20%	17%	74%	89%	91%
5%	2%	1%	40%	21%	18%	75%	89%	92%
6%	2%	2%	41%	22%	19%	76%	90%	92%
7%	3%	2%	42%	23%	20%	77%	90%	92%
8%	3%	2%	43%	23%	21%	78%	91%	93%
9%	4%	3%	44%	24%	22%	79%	91%	93%
10%	4%	3%	45%	26%	23%	80%	92%	94%
11%	4%	3%	46%	27%	25%	81%	92%	94%
12%	5%	4%	47%	28%	27%	82%	93%	94%
13%	5%	4%	48%	30%	30%	83%	93%	95%
14%	6%	4%	49%	33%	34%	84%	94%	95%
15%	6%	5%	50%	62%	60%	85%	94%	95%
16%	7%	5%	51%	68%	67%	86%	94%	96%
17%	7%	5%	52%	70%	71%	87%	95%	96%
18%	8%	6%	53%	72%	74%	88%	95%	96%
19%	8%	6%	54%	74%	76%	89%	96%	97%
20%	8%	6%	55%	75%	77%	90%	96%	97%
21%	9%	7%	56%	76%	78%	91%	97%	97%
22%	9%	7%	57%	77%	80%	92%	97%	98%
23%	10%	8%	58%	78%	81%	93%	97%	98%
24%	10%	8%	59%	79%	82%	94%	98%	98%
25%	11%	9%	60%	79%	83%	95%	98%	99%
26%	12%	9%	61%	80%	83%	96%	98%	99%
27%	12%	9%	62%	81%	84%	97%	99%	99%
28%	13%	10%	63%	82%	85%	98%	99%	99%
29%	13%	10%	64%	82%	86%	99%	100%	100%
30%	14%	11%	65%	83%	86%	100%	100%	100%
31%	14%	11%	66%	84%	87%			
32%	15%	12%	67%	84%	88%			
33%	16%	13%	68%	85%	88%			
34%	16%	13%	69%	86%	89%			

5.5 Snowfall

Maximum recorded depth	500	mm
Design snow loading	Eurocode1*	kg/m^2
Months of peak snowfall	November to February inclusive	

*Refer to Eurocode 1, NBN EN 1991-1-3 and the supplementary National Annex

5.6 Barometric Pressure

Maximum	1046	mbar
Minimum	956	mbar
Average	1016	mbar
Maximum rate of pressure change	12	mbar/h

5.7 Solar Heat

Values are for solar heat flux at the highest point of the sun (midday).

Average solar heat flux	2.7	kWh/m^2 average over 24 hours
Lowest maximum design temperature	65	^{o}C

Solar Heat	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average solar radiation [kWh/m^2/day]	0.7	1.3	2.3	3.8	4.7	5	4.8	4.2	2.9	1.7	0.8	0.5	2.7
Total solar radiation for month [kWh/m^2]	21	36	73	114	146	149	150	129	86	54	25	16	999
Average sunshine per day [hours]	1.8	2.7	3.9	5.9	6.7	6.7	6.9	6.5	4.8	3.7	2	1.5	4.4
Total sunshine [hours]	56	77	120	176	208	201	213	201	144	115	61	47	1619

Table 7: Solar Heat Flux

5.8 Thunderstorms

Thunderstorms present	Yes
Average number of days with thunderstorms per year	20
Maximum number of days with thunderstorms in one month	11 Days
Maximum number of days with thunderstorms for any one year	40 Days
Localised tornadoes present	Yes, loading as per NBN EN 1991-1-4 ANB Sec 4

5.9 Temperature Inversion

Temperature inversion present	Yes
Main months of occurrence	December, January and February (and can occur around this period)
Duration	Several Days

5.10 Canal Environment

Salt Spray present	No	
Canal water Conductivity	9600 to 23000	µS/cm at 20°C

Kanaaldok B2	Min.	Normal	Max.
Water Temperature (°C)	6.0	13.8	23.9
Water Level (m TAW*)	+3.90	+4.17	+4.45

*Tweede Algemene Waterpassing

5.11 Tidal Differences (Zwijndrecht only)

Maximum 5.42m

5.12 Frost Level

Design frost level 0.7 m

5.13 Earthquake Rating

Seismic Design Criteria	Site specific design response spectra as per Fugro PHSA Report 147299_REP_INEOS_SHA_2019 For Zwijndrecht site refer to Seismic Design Code for seismic design criteria
Importance Class (A)	Class IV for Equipment, Buildings and Structures
Importance Factor (A)	1.4 for Equipment, Buildings and Structures
Seismic Design Code	NBN EN 1998-1 and supplementary EC8 Belgium Annex NBN EN 1998-1 ANB

Note A – considering ‘very low’ seismicity & site specific PGA/ spectral acceleration values lower than code recommended criteria.

5.14 Flooding

Design for flood conditions	No

5.15 Atmospheric Conditions

Location	Coastal

Corrosivity Classification (1)	Category C5 (very high)
Durability (2)	H (15 to 25years)

Notes:
(1) NBN EN ISO 12944-2:2018, Table 1
(2) NBN EN ISO 12944-1:2018, Art 5.5, Table 1

5.16 Groundwater

Design Groundwater level	Shall be considered at finished grade (high point of paving) considering groundwater fluctuations and climate change effects
Monitoring Report North Site, Lillo	1319-0065.MR01
Monitoring Report South Site, Lillo	1319-0065.MR02

6. ECONOMICS

Section Deleted

7. UTILITIES

All utilities conditions listed are available at battery limits of all plant units at grade elevation, unless stated otherwise, with the exception of Zwijndrecht (conditions provided in Attachment 1).

7.1 Steam

7.1.1 Steam Conditions at Boiler Plant

	Value	Unit
Maximum Silica	0.02	ppm
Cation Conductivity	0.2	µS/cm at 25°C

	Pressure (bar(g))				Max. Temp. (°C)
	Min.	Normal	Max.	Design	
S110 Steam	110	115	120	135	525
S42 Steam	38	42	44	49	395

Note: Steam pressure levels within Licensor packages shall be specified by the Licensors.

7.1.2 Steam Conditions for Process and Utility Units

	Pressure (bar(g))				Temperature (°C)			
	Min.	Normal	Max.	Design	Min.	Normal	Max.	Design
S110 Steam	107.5	110	112.5	135	510	515	520	540
S42 Steam	38	42	44	49	385	390	395	420
S5 Steam	4.5	5	5.5	7	175	180	185	210

Note: Steam pressure levels within Licensor packages shall be specified by the Licensors.

7.1.3 Steam Turbines

Steam conditions at the turbine inlet and outlet will be defined by the Licensor/ turbine manufacturer.

7.2 Steam Condensate

Steam condensate shall be recovered as far as is economical within the process units. Steam condensate shall be segregated into:

- Turbine condensate – condensate from condensing steam turbines condensed against cooling water or air
- Clean condensate – condensate from steam heaters in which the steam normal operating pressure exceeds the process (hydrocarbon) maximum operating pressure by at least 1.0 bar.
- Potentially contaminated condensate – condensate from steam heaters in which the steam normal operating pressure is less than the process (hydrocarbon) normal operating pressure plus 1.0 bar.

Turbine condensate and clean condensate may be recycled within the process units to the ISBL deaerators, subject to agreement with licensors. Potentially contaminated condensate is pumped to the OSBL area for treatment and recycling. The condition of the potentially contaminated condensate at the process unit battery limit shall be:

Pressure (bar(g))				Temperature (°C)			
Min.	Normal	Max.	Design	Min.	Normal	Max.	Design
4.5	5.0	6.0	6.5	15	40	100	100

7.3 Water

7.3.1 Dock Water

Dock water is to be used as emergency fire water back up.

	Min	Max	Units
pH	7.35	8.50	
Electrical Conductivity	1030	23000	µS/cm at 25°C
Total suspended solids	2.0	73.0	mg/l
Total dissolved oxygen	7.4	11.7	mg/l
Calcium	100	210	mg/l
Magnesium	95	550	mg/l
Total Hardness	645	2800	mg/l (as CaCO3)
Chlorides	1200	7210	mg/l
Free Chlorine	n/a	n/a	mg/l
Fluoride	not reported		mg/l
Cyanide	not reported		mg/l
Zinc	<0.012	0.11	mg/l
Copper	0.0037	0.07	mg/l
Aluminium	not reported		mg/l
Total Iron	not reported		mg/l
Manganese	not reported		mg/l
Chrome		0.021	mg/l
Sulphide	not reported		mg/l
Arsenic	0.0016	0.026	mg/l
Lead	<0.0024	0.021	mg/l
Mercury	<0.00010	0.00440	mg/l
Nitrates (as N)	0.79	4.05	mgN/l
Nitrites (as N)	<0.010	0.47	mgN/l
Ammonia	<0.05	0.82	mgN/l
Phosphates	0.06	0.26	mgP/l
Sulphates	220	1100	mg/l
Total Organic Carbon	3.5	7.5	mg/l
Total Bacteria	not reported		CFU/ml
Total Coliforms	not reported		CFU/100 ml

7.3.2 City Water

City Water is received over the fence from the utility company Water-Link.

Pressure (bar(g))	
Min.	Max.
1.5	3.0

It is imported for use as Service Water (Section 7.3.4) and Drinking Water (Section 7.3.5). The quality of City Water is:

Parameter	Average	Min	Max	Percentile 05	Percentile 95	Units
Microbiological Parameters						
Escherichia coli (E. coli)	<1	<1	<1	0	0	CFU/100ml
Enterococcus	<1	<1	<1	0	0	CFU/100ml
Chemical Parameters						
Antimony	<0.5	<0.5	<0.5	0	0	µg/l
Arsenic	<1	<1	1.2	0	0	µg/l
Benzene	<0.1	<0.1	<0.1	0	0	µg/l
Benzo(a)pyrene	<0.005	<0.005	<0.005	0	0	µg/l
Boron	0.033	0.024	0.058	0.026	0.04	mg/l
Bromate	<0.5	<0.5	3.5	0	1.3	µg/l
Cadmium	0.16	<0.1	0.36	0	0	µg/l
Chrome	<1	<1	3.1	0	0	µg/l
Copper	0.003	<0.001	0.032	0.001	0.008	mg/l
Cyanide	<2	<2	<2	0	0	µg/l
1, 2- dicholoroethane	<0.1	<0.1	<0.1	0	0	µg/l
Fluoride	0.34	<0.04	0.79	0.17	0.6	mg/l
Lead	<0.5	<0.5	1.1	0	0	µg/l
Mercury	<0.04	<0.04	<0.04	0	0	µg/l
Nickel	2	<1	6.4	1.4	2.7	µg/l
Nitrate	10.4	3.7	17	5	16	mg/l
Nitrite	<0.02	<0.02	<0.02	0	0	mg/l
Pesticides total	<0.02	<0.02	<0.02	0	0	µg/l
Atrazine	<0.02	<0.02	<0.02	0	0	µg/l
Simazine	<0.02	<0.02	<0.02	0	0	µg/l
Terbutylazine	<0.02	<0.02	<0.02	0	0	µg/l
Chlorotoluron	<0.02	<0.02	<0.02	0	0	µg/l
Duiron	<0.02	<0.02	<0.02	0	0	µg/l
Isoproturon	<0.02	<0.02	<0.02	0	0	µg/l
Selene	<1	<1	<1	0	0	µg/l
Trihalomethanes total	26	9.4	57	13	41	µg/l
Bromodichloromethane	2.7	0.3	10	0.4	7.2	µg/l
Styrene	<0.1	<0.1	<0.1	0	0	µg/l
Indicator Parameters						
Aluminium	37	3	136	11	67	µg/l
Ammonium	<0.02	<0.02	0.06	0	0	mg/l
Chloride	59	<2	90	39	86	mg/l
Clostridium Perfringens (+spores)	<1	<1	<1	0	0	CFU/100ml
Color	<3	<3	<3	0	3	mg/l Pt-Co

Parameter	Average	Min	Max	Percentile 05	Percentile 95	Units
Electrical Conductivity	539	396	777	416	692	µS/cm-20°
Hydrogen ion concentration	8.2	8.2	8.7	7.8	8.2	pH
Iron	<10	<10	80	0	0	µg/l
Manganese	<2	<2	17	0	0	µg/l
Sulphate	60	>5	94	45	87	mg/l
Sodium	42	11	71	27	60	mg/l
Cell count at 22°C	4	<1	58	1	11	CFU/100ml
Colibacteria	<1	<1	<1	0	0	CFU/100ml
Total Organic Carbon (TOC)	1.8	1.2	5.3	1.3	2.4	mg/l
Turbidity	<0.2	<0.2	1.4	0	0.3	NTU
Free residual chlorine	177	<49	410	100	300	µg/l
Temperature	14	3.4	25	5.1	23	°C
Additional Parameters						
Calcium	62	46	83	51	74	mg/l
Magnesium	8	3.9	11	5.6	9.7	mg/l
Phosphorus	<100	<100	<100	0	0	µg/l
Potassium	4.9	3.4	7.1	3.7	6.3	mg/l
Total Hardness	18	14	23	15	22	°F
Zinc	7	<5	48	0	16	µg/l
Silica	1.63	0.25	3.27	0.48	3.01	mg/l
Total Alkalinity	2.19	1.55	2.92	1.75	2.69	mmol/l

7.3.3 Desalinated Water

Desalinated water will be used as cooling tower make-up only. The composition of desalinated water is as follows:

Parameter	Average	Max	Units
Sodium	5.1	20	mg/L
Potassium	0.6	2	mg/L
Calcium	7.6	12	mg/L
Calcium as $CaCO_3$	19.0	30	mg/L
Magnesium	0.9	2.5	mg/L
Chloride	5.7	30	mg/L
Sulphate	6.3	20	mg/L
Total alkalinity	21.8	24.4	mg/L
Total alkalinity as $CaCO_3$	18.0	20	mg/L
Phosphate	0.01	0.1	mg/L
Nitrate	2.30	6	mg/L
Fluoride	0.05	0.4	mg/L
Iron	< 0.01	0.02	mg/L
Zinc	< 0.01	0.02	mg/L
Silica	0.5107	2	mg/L
pH	6.5-7.5	5.5-8.5	-
TOC	< 0.5	< 1	mg/L
Temperature	13	1-25	°C

7.3.4 Service Water

Service water is distributed to users for general utility use and fire water make-up. The service water shall consist of City Water only (see Section 7.3.2).

Service water is distributed at pressure to users for general use at the conditions below:

	Min.	Normal	Max.	Design
Supply Pressure (bar(g))	4.5	5.0	6.0	10.0
Supply Temperature (°C)	6	14	24	50

7.3.5 Drinking Water

Drinking water is distributed to users at the conditions as stated. Drinking Water quality is the same as City Water (see Section 7.3.2).

	Min.	Normal	Max.	Design
Supply Pressure (bar(g))	3.5	4.0	4.3	6.0
Supply Temperature (°C)	5.0	13	22	60

7.3.6 Firewater

Firewater is supplied from the Service Water system, or exceptionally from dock water during a major event where large volumes are required. Separate firewater systems are installed for the North and South sites. .

	Min.	Normal	Max.	Design
South Site Supply Pressure (bar(g))	10.0	12.0	12.0	16.0
Supply Temperature (°C)	6	14	20*	50

*Note that the maximum operating conditions shall be used for material selection of underground firewater piping

7.3.7 Cooling Water

The common cooling system will supply OSBL facilities. The conditions at unit battery limit are as follows:

	Min.	Normal	Max.	Mechanical Design (Above ground)	Mechanical Design (Large underground headers)
Supply Pressure (bar(g))	3.5	3.75	3.75	10.0	10.0
Supply Temperature (°C)	15	25	27	70	50
Return Pressure (bar(g))	2.0	2.25	2.25	10.0	10.0
Return Temperature (°C)	A	A	A	70	50

Note A: Cooling water shall be designed with a temperature rise of 15°C to minimise recirculation

Maximum chloride content 400 ppm

ECR have their own dedicated cooling systems with conditions to be determined by the respective Engineering Contractors.

7.3.8 Demineralised Water

Demineralised water supplied to users is a mixture of demineralised water from Water Link and the treated condensate (polished water). It is supplied with the following quality:

Parameter	Specification	Unit	Method	Remark
pH value (25 °C)	6 - 8	-	ASTM D 1293	
Acid Conductivity (25°C)	< 0.2	µS/cm	ASTM D 4519	Measured downstream of cationic exchanger
Copper	< 0.003	mg/l	ASTM D 1688	
Sodium	< 0.005	mg/l	ASTM D 4191 / D 6071	
Total Iron	< 0.01	mg/l	ASTM D 1068	
Total Silica	< 0.02	mg/l	ASTM D 859	
Total Organic Carbon (TOC)	< 0.2	mg/l	ASTM D 4779 / D 5173	
Colloidal Silica	Free			

Supply conditions of demineralised water to users at the process unit battery limit shall be confirmed via Interface Query (IQ)/ Battery Limit Interface Schedule (BLIS).

7.3.9 Boiler Feed Water

Demineralised water is supplied to licensed process units. Boiler Feed Water (BFW) is prepared inside battery limits as required.

7.4 Air

7.4.1 Instrument Air

New instrument air systems shall be provided. Instrument Air shall not be backed up by Nitrogen.

	Min.	Normal	Max.	Design
Header Pressure (bar(g))	5.5	7	7.8	10.5
Supply Temperature (°C)	25	35	35	65

Pressure Dew point	-40.0	°C
Oil content	None	
Compressor driver	Electric	
Instrument air hold up time on power failure	15	minutes
Instrument air supply for actuator sizing	4.5	bar (g)

7.4.2 Plant Air

New plant air systems shall be provided from the Instrument Air system. Conditions and quality will be identical to Instrument Air.

7.4.3 Nitrogen

Nitrogen shall be supplied from the local distribution network at 28 bar(g).

On-site distribution shall be at the following conditions:

	Min.	Normal	Max.	Design
N28 Header Pressure (bar(g))	26.7	28	29	32
N6 Header Pressure (bar(g))	6	6.5	7	8
Header Temperature (°C)	-5	15	27	65

Hold-up Capacity on power failure	None	
Dew point	-70.0	°C at 7 bar(g)
Oxygen	5	ppm v/v (maximum)

Note 1- Nitrogen shall never be used as a motive medium.

Note 2- Further details regarding the supply specification will be available once the nitrogen supplier has been decided.

7.5 Fuel

7.5.1 Fuel Gas

Fuel gas is controlled internally in the ECR unit. Excess fuel gas from licensed units is routed for supply to the OSBL boilers. Fuel gas conditions at ECR battery limit are:

	Pressure (bar(g))			Temperature (°C)		
	Min.	Normal	Max.	Min.	Normal	Max.
Header	3.5	4.0	4.0	20	40	50

Fuel gas burners will be specified with the capability to process both Natural Gas and Hydrogen-rich Process Units Off-gas.

7.5.1.1 Natural Gas

Natural gas is imported from the local utility (Fluxys), is let down and distributed to users at a pressure of 12.0 bar(g) and ambient temperature.

	Pressure (bar(g))		
	Min.	Normal	Max.
Natural Gas	7.5	12.0	16.0

Natural gas is a blend from multiple sources with typical compositions (2018 average) as shown in the table below:

Fuel Gas #1 Properties		Fluxys Natural Gas Source					Units
Natural Gas	Typical	EYNATTEN 1 (18)	SEGEO (20)	LNG (29)	IZTF (34)	ZPT (91)	
Capacity	-	-	-	-	-	-	kg/h

Fuel Gas #1 Properties	Fluxys Natural Gas Source						Units
Molecular Weight	17.6	16.7	17.5	17.1	17.7	17.8	kg/ kg mol
Lower Heating Value	47486	48950	47364	49377	46820	46925	kJ/kg
Wobbe Index	52400	53268	52820	54344	52520	52767	kJ/Nm^3
Composition							
Hydrogen	0.00	0.00	0.00	0.00	0.00	0.00	% vol
Methane	90.51	96.29	91.96	93.25	90.92	91.16	% vol
Ethane	4.85	2.59	4.84	5.86	4.78	4.65	% vol
Ethylene	0.00	0.00	0.00	0.00	0.00	0.00	% vol
Propane	1.14	0.15	0.65	0.32	0.99	1.08	% vol
Propylene	0.00	0.00	0.00	0.00	0.00	0	% vol
i-Butane/n-Butane	0.36	0.07	0.24	0.15	0.31	0.40	% vol
i-Butylene	0.04	0.00	0.00	0.00	0.00	0	% vol
i-Pentane/n-Pentane	0.04	0.01	0.05	0.00	0.07	0.10	% vol
Pentane +	0.05	0.01	0.04	0.00	0.05	0.07	% vol
Nitrogen	1.68	0.45	0.91	0.41	1.56	0.90	% vol
Carbon Dioxide	1.31	0.42	1.29	0.00	1.31	1.63	% vol
Carbon Monoxide	0.00	0	0	0	0	0	% vol
Water	0.00	0	0	0	0	0	% vol
Hydrogen Sulphide	0.03	0.56	0.10	1.53	0.05	0.96	ppm v/v

Natural gas supply is guaranteed by Fluxys to meet the following conditions:

Fuel Gas #1 Properties – Natural Gas	Gas Supplier (Fluxys) Guarantee Spec.				Units
Lower Heating Value	Min:	41976	Max:	52307	kJ/kg
Wobbe Index	Min:	47016	Max:	57996	kJ/Nm^3
Temperature	Min:	Minus 10	Max:	38	°C
Hydrogen Sulphide content (H2S)	Min:	-	Max:	3.5	ppm v/v

8. PIPING

8.1 Category D and Category M Fluid Services

These fluids shall be identified on the Line Classification Lists produced by the Engineering Contractor.

8.2 Severe Cyclic Service Lines

ASME B31.3 requires the designer to identify those lines subject to severe cyclic conditions. These conditions exist where S_ε (Computed Stress) exceeds 0.8 S_A (Allowable Stress) and the equivalent number of cycles exceeds 7000; or where other conditions will produce an equivalent effect. Refer to ASME B31.3 for further details.

Lines in severe cyclic service shall be identified during SELECT/DEFINE stages and be included on the Line Classification List produced by the Contractor.

9. ELECTRICAL

The below is applicable to all areas of Project One, excepting Zwijndrecht which is detailed in Attachment 1.

9.1 Power Supply

Incoming Power		
Nominal Voltage	380	kV (3 phase +/- 5%)
Nominal Frequency	50	Hz (+/- 2%)
Power	180	MVA
In Plant Generation		
Power Generation method	Steam Turbine	
Power Island operation	Yes	
Export Power	No	
Voltage	11	kV [3 phase]
Frequency	50	Hz
Power	2 x 30MW 0.8pf	MW at site design conditions
External Interfaces		
With Utility Company	Yes	At 380 kV
With Power Plant	Yes	Provision only
With Existing Facility	Yes	At 36kV with Polymer plant
With Third Parties	No	
HV Distribution		
Nominal Voltages	36	kV (3 phase +/- 5%)
	11	
	6	
Nominal Frequency	50	Hz (+/- 2%)
Area battery limit power source	Area substation HV transformer primary terminals	
Maximum 3 phase fault level	41450 MVA at 380 kV	
Emergency power to be provided for	Process loads, Uninterruptible Power Supply (UPS), Lighting, HVAC System	
Uninterruptible Power Supply		
AC UPS for critical instrument loads	Yes	230 V
AC UPS for critical telecoms loads	Yes	230 V
AC UPS for other critical loads	Yes	230 V
AC UPS for LV switchgear protection, metering, control	Yes	230 V
DC UPS for HV switchgear protection, metering, control	Yes	110 V
AC UPS Neutral grounded	No	
DC UPS floating	0 V (tied to ground)	

9.1.1 Utilisation Voltages

Service	Power Range (kW)		Voltage (Note 1)	Phase (Note 2)
	From	To		
Main Power Distribution			36 kV	3
Motors	>4000		10kV)	3
	>250	≤4000	6 kV	3
	>0.18	≤250	690 V	3
		≤0.18	230 V	1 + N
LV Power Distribution to non-critical, non-process loads			400 V	3 + N + G
Instruments			230 V	1 + N + G
Telecoms			230 V	1 + N + G
Lighting Distribution			230 V	1 + N + G

Note 1 – Tolerance on nominal voltage is ± 5%
Note 2 - Nominal frequency is 50 Hz with tolerance ± 2%

9.2 Hazardous Area Classification

Details provided in Hazardous Area Classifications Basis and Review Procedure (7650-8820-PR-100-0011).

10. UNITS OF MEASUREMENT

10.1 System of Measurement

The system of measurement shall be generally the International System of Units (SI), however for certain properties see units to be used below.

Property	Unit(s)	Unit Description
Acceleration	m/s^2	Metres per second squared
Area	m^2	Metres squared
Calorific Value (Mass Base)	kJ/kg	Kilojoules per kilogram
Calorific Value (Volume Base)	kJ/m^3	Kilojoules per metres cubed
Composition	% wt % mol	Percentage by weight Percentage by mole
Concentration (Mass/Mass)	mg/kg	Milligrams per kilogram

Property	Unit(s)	Unit Description
Concentration (Substance)	mol/m³ ppb v/v ppm v/v ppm wt mg/l % wt % mol % vol CFU/100ml	Moles per metres cubed Parts per billion by volume Parts per million by volume Parts per million by weight Milligrams per litre Percentage by weight Percentage by mole Percentage by volume Colony forming unit/100 millilitres
Density	kg/m^3	Kilograms per metres cubed
Electrical Current	A mA	Ampere Milliampere
Electrical Voltage	mV V kV	Millivolt Volt Kilovolt
Electrical Conductivity	µS/cm	Microsiemens per centimetre
Enthalpy	kJ/kg	Kilojoules per kilogram
Equipment Dimension & Pipe Lengths	mm	Millimetre
Flow liquid (volumetric)	m^3/h	Metres cubed per hour
liquid (mass)	kg/h t/h	Kilograms per hour Tonnes per hour
gas (volumetric)	Nm^3/h l/h	Normal metres cubed per hour Litres per hour (for analysers)
gas (mass)	kg/h t/h	Kilograms per hour Tonnes per hour
Steam (mass)	kg/h t/h	Kilograms per hour Tonnes per hour
Force	N	Newton
Fouling Resistance	m^2 K/W m^2 ^{o}C/W	Metres squared kelvin per watt Metres squared celsius per watt
Frequency	Hz kHz	Hertz Kilohertz
Hardness (water)	^{o}F	French degrees
Heat Absorption	W/m^2	Watts per metres squared
Heat Content	kJ MJ	Kilojoule Megajoule
Heat Duty	kW MW	Kilowatt Megawatt

Property	Unit(s)	Unit Description
Heat Transfer Coefficient	$W/m^2 K$	Watts per metres squared kelvin
Length	mm m	Millimetres Metres
Level	Mm %	Millimetre Percent
Mass	kg t	Kilogram Tonne
Molar Quantity	kg mol	Kilogram mole
Molecular Weight	kg/kg mol	Kilograms per kilogram mole
Mole Flow Rate	kg mol/h	Kilograms mole per hour
Nozzle & Flange Size	in	Inch (nominal)
Piping Diameter	in	Inch (nominal)
Plot Plan Dimensions	mm	Millimetre
Process Unit Capacity	kta	Kilotonnes annually
Power	kW MW	Kilowatt Megawatt
Pressure (below atmospheric)	bar(a) mbar(a)	Bar (absolute) Millibar (absolute)
Pressure (above atmospheric)	bar(g) mbar(g) bar(a) mbar(a)	Bar (gauge) Millibar (gauge) Bar (absolute) Millibar (absolute)
Pressure (vacuum/ tank blanketing/ draft)	mbar(g)	Millibar (gauge)
Pressure (drop)	Bar mbar	Bar Millibar
Sound Pressure Level	dB(A)	Decibel (A weighting) at 1m
Sound Power Level	dB(A)	Decibel (A weighting)
Specific Heat	kJ/kg K	
Surface Tension	mN/m	Millinewtons per metre

Property	Unit(s)	Unit Description
Temperature	°C	Degrees celsius
Thermal Conductivity	W/m K	Watts per metre kelvin
Thermal Resistivity	K m/W	Kelvin metre per watt
Time	sec min h day yr	Second Minute Hour Day Year
Torque	N m	Newton metre
Tubing Size	mm	Millimetre
Turbidity	NTU	Nephelometric Turbidity Units (NTU)
Velocity	m/s	Metres per second
Velocity (angular)	rad/s	Radians per second
Viscosity, kinematic	cSt	Centistoke
Viscosity, dynamic	mPa s	Millipascal second
Volume, liquid	m^3	Metres cubed
Volume, gas	Nm^3	Normal metres cubed

Actual conditions for gas shall use the flowrate as given in m^3/h at the operating conditions and be identified by the use of 'A' (e.g. Am^3/h, etc). Operating conditions shall be provided alongside the use of actual conditions, for clarity.

Normal reference conditions for gas and vapour shall be at 0°C and 1.01325 bar(a) identified by use of 'N' (e.g. Nm^3/h, Nm^3 etc), otherwise units shall be assumed to be at actual conditions.

Standard reference conditions for liquids shall be at 15°C and1.01325 bar(a) identified by use of 'S' (e.g. Sm^3/h, Sm^3 etc), otherwise units shall be assumed to be at actual conditions.

It shall be noted that the preference for Project One is to use mass rather than volume when defining parameters.

10.2 Date and Number Representation

10.2.1 Date

The date shall be represented in the format dd mmm yyyy . For example, the 6th day of August 2019 would be written as: 06 Aug 2019.

10.2.2 Number

The “fractional (or decimal) separator” shall be the point (“.”) and this denotes the separation of the integer part from the fractional part of the number.

There shall be no “thousands separator”.

Where a number would be shown as having greater than four integers, or more than four fractional places, an alternative unit should be considered.

Examples of the number format are shown below:

- 3.25 m (three and one quarter metres)
- 1.01325 x 10^5 Pa
- 0.2547 V or 254.7 mV
- 13312.25 m or 13.31225 km

The number of significant figures is dependent on the context. For example, 13.31225 km may be better shown as 13.31 km. Whereas, 1.01325 x 10^5 Pa would remain unchanged.

Other units (not shown here) may be used only where necessary, and with the prior approval of IPMT.

11. SPECIAL PROGRAM REQUIREMENTS

11.1 Document and Drawing Language Translation

The program language shall be English. However, there shall be a requirement to translate some key documents into the Dutch language. These shall include any document required as part of formal communication with the government (e.g. Overview plans and schedules, reports, permit applications), safety related items, equipment manuals and handbooks.

ATTACHMENT 1– Zwijndrecht Site

All above sections of the BEDD are applicable to the Project One scope of work at Zwijndrecht site, excepting Section 7 Utilities and Section 9 Electrical. Zwijndrecht specific conditions are given below.

A.1 Utilities

FLUID/SYSTEM	DESIGN PRESSURE (bar g)	OPERATING PRESSURE (bar g)			DESIGN TEMP. (°C)	OPERATING TEMPERATURE (°C)		
		Min	Norm	Max		Min	Norm	Max
Nitrogen * 350# system *100# system * Etox Refining	27.5 7.6 10.35	22 6.0 6.0	24 7.0 7.0		50 50 50	Ambient Ambient Ambient		
Instrument/Plant Air	9.4	6.0	7.4/ 8.2		50	Ambient		
Cooling Water Supply	7.0	2.2	3.0	5.5	75	18	22	35
Cooling Water Return	7.0	0.5	2.0		75	27	25	46
Steam • 600# superheated • 600# saturated • 400# • 100# • 50# Utilities • 30# Terminal • 25#	 45.5 44.8 31 8.6 5.2 4.6 2.1		 40 38.5 25 7 3 3.5 1.75		 400 260 240 225 225 225 215		 380 255 225[1] 185 148 148 130	
Boiler Feed Water	68	48	50		145		125	
Proces Water	10.6		5.0	5.5	50	Ambient		
Fire Water	10.0		8.0	8.7 5	50	Ambient		
Drinking (city)Water New syst. (2020 and later)	5.0 7.0	2.5 3.0	3.5 4.0	5.0	50 50	Ambient Ambient		
Demineralised water Chemicals syst. Allyl Pag's syst. New syst. (2020 and later)	 5.5 7.6 8.5	 3 6 6	 4 7 7	 7.5	 100 100 100	 Ambient Ambient Ambient		
Natural Gas [2]	9.7	6.0	6.5	8.0	50	Ambient		

[1] Temperature at saturated condition. Steam is superheated at 250°C at the pressure reduction station.

[2] Tie-in on the natural gas supply header upstream of the actual reduction station would provide ± 21 bar(g) natural gas pressure (design pressure 40.0 barg). Design pressure of the existing filters in the high pressure inlet piping to the reduction station is 70 barg.

A.2 Electrical

A.2.1 Power Supply

Incoming Power		
Nominal Voltage	36	kV (3 phase +/- 5%)
Nominal Frequency	50	Hz (+/- 2%)
Power	14.5 (To be confirmed during DEFINE and communicated within AZP)	MVA
HV Distribution		
Nominal Voltages	36	kV (3 phase +/- 5%)
	6	kV (3 phase +/- 5%)
Nominal Frequency	50	Hz (+/- 2%)
Area battery limit power source	The battery limit between Contractors is at the edge of SS39	
Maximum 3 phase fault level	31.5kA (Switchgear S39H/H4) (To be confirmed during DEFINE and communicated within AZP)	
Emergency power to be provided for	Process loads, Uninterruptible Power Supply (UPS), Lighting, heat tracing and space heaters	
Uninterruptible Power Supply		
AC UPS for critical instrument loads	Yes	230 V
AC UPS for critical telecoms loads	Yes	230 V
AC UPS for other critical loads	Yes	230 V
DC UPS for switchgear protection, metering, control	Yes	110 V
AC UPS Neutral grounded	Yes	
DC UPS floating	0V	

Note 1: If the decision is made to build a new substation, the same system as Lillo shall be applied. However, if the decision is to extend the Oxide substation then the above shall be applied.

A.2.2 Utilisation Voltages

Service	Power Range (kW)		Voltage (Note 1)	Phase (Note 2)	Remarks
	From	To			
Main Power Distribution	>4000		36 kV	3	
Motors	>400	≤4000	6 kV	3	
	>132	≤400	690 V	3	Main LV Switchgear
		≤132	690 V	3	MCC
LV Power Distribution to non-critical, non-process loads			400 V	3 + N + G	
Instruments			230 V	1 + N + G	

Telecoms			230 V	1 + N + G	
Lighting Distribution			230 V	1 + N + G	

Note 1 – Tolerance on nominal voltage is ± 5%
Note 2 - Nominal frequency is 50 Hz with tolerance ± 2%